# The Singlet Lines of Cl IV

I. S. BOWEN, *California Institute of Technology*
(Received July 18, 1934)

Ten singlet and intercombination lines of Cl IV have been classified and the singlet terms of the ground configuration located. Forbidden transitions between the terms of the ground configurations of Cl IV, Cl III and probably S III are not observed in nebulae or novae.

TABLE I lists a small group of strong singlet and intercombination lines which

TABLE I. *Singlet lines of Cl IV.*

| Int. | λ | ν | Classification |
|---|---|---|---|
| 2 | 331.835 | 301355. | $s^2p^2\ ^1D-s^2p5s\ ^1P$ |
| 8 | 486.172 | 205689. | $s^2p^2\ ^1D-s^2p4s\ ^1P$ |
| 4 | 535.039 | 186902. | $s^2p^2\ ^1S-s^2p4s\ ^1P$ |
| 2 | 599.733 | 166741. | $s^2p^2\ ^3P_0-sp^3\ ^1P$ |
| 5 | 601.499 | 166251. | $s^2p^2\ ^3P_1-sp^3\ ^1P$ |
| 5 | 604.590 | 165401. | $s^2p^2\ ^3P_2-sp^3\ ^1P$ |
| 4 | 653.696 | 152976. | $s^2p^2\ ^1D-sp^3\ ^1P$ |
| 3 | 662.454 | 150954. | $s^2p^2\ ^1D-sp^3\ ^3S$ |
| 4 | 745.205 | 134191. | $s^2p^2\ ^1S-sp^3\ ^1P$ |
| 1 | 756.563 | 132177. | $s^2p^2\ ^1S-sp^3\ ^3S$ |

have been identified recently in Cl IV. The corresponding term values, fixed relative to the triplet values previously published,[1] are given in Table II.

TABLE II. *Singlet term values of Cl IV.*

| | |
|---|---|
| $s^2p^2\ ^1D$ | 417460 |
| $s^2p^2\ ^1S$ | 398676 |
| $sp^3\ ^1P$ | 264484 |
| $s^2p4s\ ^1P$ | 211772 |
| $s^2p5s\ ^1P$ | 116105 |

This analysis and the previous classifications of Cl III and Cl IV yield the values given in Table III for the wave-lengths of the forbidden transitions from the metastable terms of the ground configurations. As none of these lines have been observed in either nebulae or novae it is evident that chlorine is not an abundant element in these objects.

A similar attempt at the analysis of the singlets of S III did not lead to unambiguous results because two or three crucial lines in the most probable arrangement are blended with other O or S lines and because many of the high level terms are erratic, due to the overlapping of the $s^2p3d$ and $s^2p4s$ configurations. If this most probable arrangement is correct, then the $^1S$ and $^1D$ terms of the $s^2p^2$ configuration occur at 27,601 and 11,322 $cm^{-1}$, respectively, above the lowest state ($^3P_0$). Transitions between terms with the above values do not correspond to any observed nebular lines. While these values are somewhat uncertain, an interpolation between Si I and Cl IV, as well as the series limits in S II, fix the position of these terms within a few hundred reciprocal centimeters of the above values and thus exclude the identification of any of the stronger unidentified nebular lines with transitions between these terms.

TABLE III. *Forbidden transitions from metastable states in chlorine.*

| Cl III | | Cl IV | |
|---|---|---|---|
| $s^2p^3$ | λ | $s^2p^2$ | λ |
| $^4S-^2P_{1\frac{1}{2}}$ | 3342.7 | $^3P_1-^1S$ | 3118.3 |
| $^4S-^2P_{\frac{1}{2}}$ | 3353.4 | $^1D-^1S$ | 5322.2 |
| $^4S-^2D_{2\frac{1}{2}}$ | 5517.2 | $^3P_1-^1D$ | 7531. |
| $^4S-^2D_{1\frac{1}{2}}$ | 5537.7 | $^3P_2-^1D$ | 8046. |

[1] I. S. Bowen, Phys. Rev. **45**, 401 (1934).